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EDITORIAL

CHRISTMAS

As age takes its toll and our years unfold with a seemingly ever-increasing rapidity, men who are old and mature delve in their store of memory. They compare the past with the present and try to forecast the future.

Memory is kind, and it is inclined to store pleasant things and discard the others: amongst all these memories the festival of Christmas with all its joy and grace stands out in great splendour. The adverse vicissitudes of the past sink into oblivion, swamped by a brief period of joy and peace when the stranger is welcome at the gate and the prodigals come home. When we view our lives in retrospect and the Christmases that have gone, we see them as beacons flashing out a great message bidding men to come together in harmony and comradeship. This has been the message for nearly two thousand years: Christmas is the time when the family spirit reigns supreme and has no rival.

It comes at the time when in the natural order of things nature is asleep and gathering strength for new tasks ahead. The glories of autumn have departed and the year is sinking to its rest.

Autumn may be the season of mists and colour and mellow fruitfulness but its glories are transient and it ushers in the time of darkness, rain and fog. These can depress the stoutest hearts, for the year is about to die and the mourners are assembling for the final obsequies. As on other and more personal occasions, they gather in sorrow to review the life and work of that

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which is about to depart and pass judgment according to their profit and expectations. They may praise or voice regret.

Few will regret the passing of 1953, for world affairs are still on edge and the great hopes which accompanied its birth have only in part been fulfilled.

"The evil that men do lives after them, the good is often interred with their bones," and when one pauses to take stock in December, 1953, the truth of that statement is all too apparent. Except for a brief period after World War I, "the war to end all wars," when only the most pessimistic thought that such a calamity could be repeated, we have lived for many years in a state of tension amidst wars and rumours of war and the machinations of evil men.

Nature, too, has been in spite in 1953 by storm and flood, as if to show her contempt for man's puny ingenuity. Nature is a benevolent mother but she can be harsh and cruel and she fetters all attempts to usurp her rightful powers. In her benevolence she will respond to some measure of direction or control, and thereby hangs the fate of mankind. Her response to the efforts which have been made to increase the food supplies of the world and ameliorate the lot of the common man is a remarkable testimony to her kindly power and the wisdom of men who work together and with her for the common good.

Let us hope that the true spirit of Christmas will embrace the world not only on December 25, but in the years to come. If amity amongst men prevails, the world can be a happy place; envy, hatred and distrust can portend a dreadful fate.

The choice is ours.

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GENERAL ARTICLES

BACTERIAL *MENINGO-ENCEPHALITIS* IN CALVES (Pasteurella infection)

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APART from infections due to *Mycobacterium tuberculosis* or *Listerella* (*Erysipelothrix*) *monocytogenes*, bacterial meningitis in farm animals has been rarely reported. While investigating the possibility of rabies as the cause of death of four buffalo calves, Mori (1917) found that the experimental rabbits which were inoculated with buffalo brain tissue developed meningitis. *Pasteurella bubaliseptica* (*P. septica*) was recovered from their brains but not from any other organ. Graham (1935 *a*, 1935 *b*) investigated "cornstalk disease" of horses in the U.S.A. and recovered pasteurella-like organisms from the brain, together with many others he was unable to identify. Johannsen (1943) had often encountered meningitis and menigo-encephalitis in young calves as part of the general syndrome "septicæmia neonatorum," and pasteurella were recovered from 6 per cent of his cases. The tissue changes in the central nervous system were similar to those encountered by us.

The present paper reports an outbreak of disease among calves in which the predominant symptoms and necropsy findings in the calves examined were those of meningo-encephalitis. *Pasteurella septica* was isolated in pure culture from the three cases which came to necropsy.

HISTORY

A large farm was involved where most of the calves were born in September and October, and from January to March. Between September 13, 1949, and April 4, 1950, thirteen of fifty-three calves died; of the total born, thirty-seven were heifer calves, nine of which died. Calves had been dying in similar circumstances on the farm before this outbreak. It is the custom on this farm to send for slaughter on a Wednesday all bull calves born during the previous week; more bull calves might have died had they been kept longer on the farm. Three bull calves sold for rearing died on the new premises. In general, however, the calves died very young.

All calves were born in a range of contiguous loose boxes, were suckled for twenty-four hours, received their dam's milk from a bucket for a further three days and were then fed bulk milk until weaning time. Although they were reared in this range of loose boxes and in two other detached boxes, there was little evidence that the disease was contagious. Cases occurred in most boxes, but others in the same group remained healthy. At the time of the outbreak the rat population on the farm was very numerous, but after our investigation a rigorous poisoning campaign kept the numbers low.

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TABLE I

Dates of birth and of death of thirteen calves in the outbreak of disease

Calf	Born	Died	Sex	Remarks
1	10. 9.1949	13. 9.1949	F.	Found dead.
2	16. 9.1949	21. 9.1949	F.	Found dead.
3	25. 9.1949	30. 9.1949	F.	Found dead.
4	23.10.1949	27.10.1949	F.	Ill for a few hours, then died.
5	16. 1.1950	18. 1.1950	M.	Ill for a few hours, then died.
6	17. 1.1950	22. 1.1950	M.	Ill for three days, then died.
7	2. 2.1950	4. 2.1950	F.	Ill for a few hours, then died.
8	7. 2.1950	9. 2.1950	F.	Ill for a few hours, then died.
9	20. 2.1950	4. 3.1950 (killed)	M.	Transferred to another farm 29.2.1950, becoming ill there 1.3.1950. First calf to be examined at the veterinary investigation centre.
10	3. 3.1950	17. 3.1950	F.	Born on another farm and transferred on day of birth to affected farm. Found dead.
11	22. 3.1950	28. 3.1950	F.	Found dead.
12	23. 3.1950	29. 3.1950	M.	Found dead; examined at the veterinary investigation centre.
13	4. 4.1950	4. 4.1950	F.	Found dead.

Symptoms

Several of the affected animals were found dead, although apparently healthy a short time before. Those which were seen to be ill collapsed quickly and became comatose with varying degrees of opisthotonous. When this was marked, the eyeballs were drawn sharply upwards and showed twitching movements. The early age at which many of the calves died is worthy of some notice.

Necropsy

Calf No. 9, received moribund, was killed by chloroform inhalation. The other animals examined arrived immediately after death.

Calf No. 9.—There was obvious meningitis, especially at the base of the brain, where a thick layer of fibrin filled the subdural space and extended along the spinal meninges for the distance of two vertebræ. No cerebrospinal fluid escaped when the neck was severed at the atlanto-occipital joint. Numerous petechial hæmorrhages or congested blood vessels were seen in sections of the brain substance, mainly in the white matter. A thin, fibrinous deposit covered the ependyma of the lateral ventricles and their choroid plexuses. No lesions were seen in any other part of the carcase apart from hyperæmia of the small intestine.

FIG. 1. Segment of medulla oblongata. Severe, acute, fibrinous meningitis penetrated by a normal nerve trunk. Hæmatoxylin and eosin. × 102.

FIG. 2. Another view of the same section. Here the exudate is fibrino-purulent. Hæmatoxylin and eosin. × 102.

FIG. 3. Sub-ependymal encephalitis in the caudate nucleus. A small corner of the lateral ventricle can be seen in the left hand top corner of the micrograph. Hæmatoxylin and eosin. × 210.

FIG. 4. Encephalitic focus in the mid brain. Hæmatoxylin and eosin. × 220.

FIG. 5. Intracerebral blood vessel containing a septic thrombus. Purulent inflammation is spreading into the surrounding tissues. Hæmatoxylin and eosin. × 220.

FIG. 6. The same as Fig. 5. × 945.

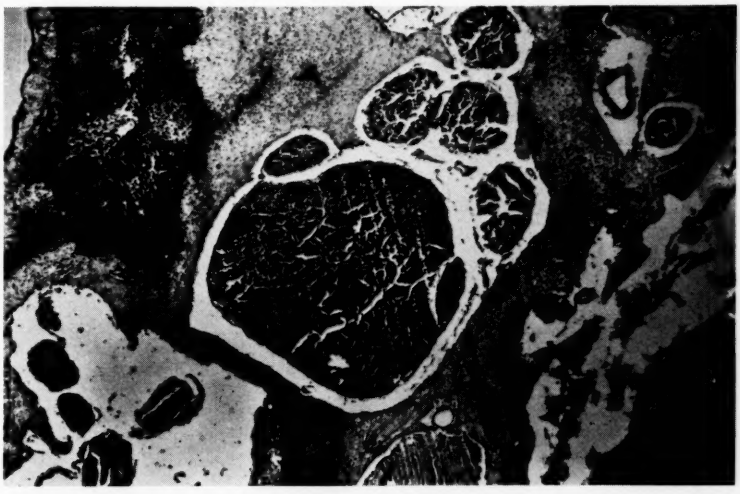

FIG. 1

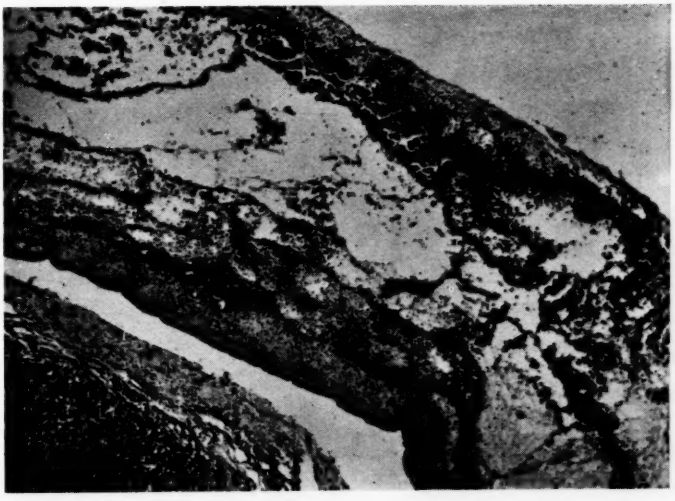

FIG. 2

(Article by Shand and Markson, page 491)

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FIG. 4

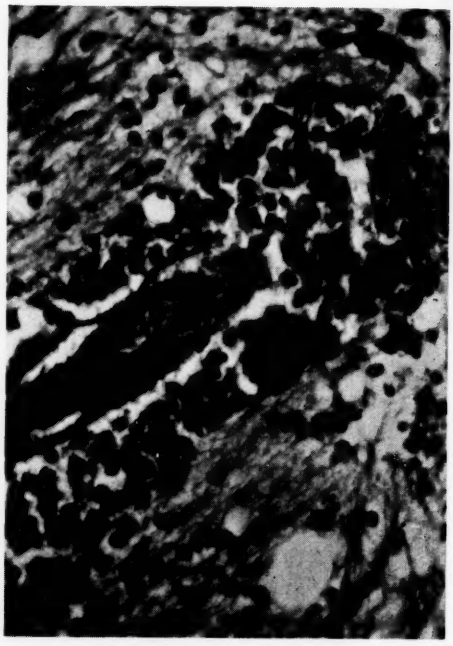

FIG. 6

FIG. 3

FIG. 5

(*Article by Shand and Markson, page* 491)

Calf No. 10.—An obvious excess of cerebrospinal fluid, normal in colour though slightly turbid, flowed from the *foramen magnum* and the vertebral canal when the carcase was decapitated. The meninges were hyperæmic. Again there were obvious petechial hæmorrhages or congested blood vessels on the cut surface of the brain. The only other abnormalities in the carcase were slight hyperæmia of the small intestine and myocardial degeneration.

Calf No. 12.—There was a great excess of cerebrospinal fluid, although the meningeal vessels were not as congested as in Calves Nos. 9 and 10. A slight, fibrinous adhesion joined the cardiac lobe of the lung to the pericardium. Apart from this, and petechial hæmorrhages around the coronary grooves, the lungs and heart were normal. The parietal pleura was slightly hyperæmic. Two one-foot lengths of the small intestine were inflamed, with enlargement of the associated lymph nodes. The other organs appeared to be normal.

Bacteriology

All the examinations were made very soon after death. A heavy inoculum of material from the following sources was stroked on to ox-blood agar and McConkey agar plates: heart blood, lung, liver, gall-bladder, spleen, kidney, gastric mucosa, small intestinal mucosa, mesenteric lymph nodes, cerebrospinal fluid and various parts of the brain. The plates were incubated aerobically for forty-eight hours at 37° C.; 1 ml. of blood from each animal was sown into 5 ml. of nutrient broth, incubated for twenty-four hours and then plated on blood agar.

Calves Nos. 9 and 10.—Heavy growths of *Pasteurella septica* were obtained from cerebrospinal fluid, posterior and anterior meninges, brain stem and fore brain. This organism was recovered also in subcultures from blood which initially had been sown in nutrient broth. No bacteria grew on the plates inoculated from thoracic and abdominal viscera.

Calf No. 12.—*Pasteurella septica* was recovered from cerebrospinal fluid, brain stem, meninges, pericardial fibrin, thoracic and abdominal viscera, umbilical vein and the mucous membrane lining the nasal aspect of the ethmoid bone.

The organism recovered was the same in each case—a small, ovoid, Gram-negative bacillus which grew profusely without hæmolysis on ox-blood agar to produce yellowish colonies up to 1 mm. in diameter. It was non-motile and did not grow on McConkey's medium; it produced acid without gas from sucrose, glucose, mannite and sorbite, but failed to ferment lactose, salicin, dulcite and maltose; it failed to change litmus milk; it formed indole and was M.R. negative and V.P. negative; it reduced nitrates and produced hydrogen sulphide. Mice which received an intraperitoneal injection of the organism died of a septicæmia in from twenty-four to forty-eight hours.

Histology

The brains of the dead calves were removed soon after death, immersed in 10 per cent formol-saline and subsequently transported to the laboratory at

Weybridge wrapped in cotton-wool soaked in the fixative. Histological sections were prepared and stained by Gram's method or by Ehrlich's hæmatoxylin followed by aqueous eosin.

Calf No. 9.—A general fibrino-purulent meningitis was particularly severe under the base of the brain, pons, medulla and the first inch of spinal cord. The meninges of the olfactory lobes were also inflamed, but no meningitis was seen around the pituitary body. A feature of the exudate was the presence in some fields of hæmosiderin-laden phagocytes, consistent with the calf having been ill for a few days. There was no visible organisation of the exudate. The ependyma of the ventricles and choroid plexuses was in a state of acute pyesis, exudate from which had penetrated the olfactory canal and the intraglandular cleft of the pituitary body, both otherwise healthy. Lesions of the brain and cord consisted of vascular congestion, small hæmorrhages and associated neutrophile infiltration. The substance of the olfactory lobes was only slightly affected. The picture suggested hæmatogenous dissemination, inwards from the inflamed meninges. In the subependymal tissue of the lateral ventricles, however, the inflammation appeared to have spread by direct contact. The condition was essentially an acute, fibrino-purulent meningo-encephalitis.

Calf No. 10.—This was a severe, bacterial, suppurative, meningo-encephalitis in which all the stages in the development of the lesions could be seen: moderately congested, severely congested and thrombosed arteries and arterioles, suppurating thrombi, and bacterial emboli, with hæmorrhages, fibrin formation and infiltration by neutrophiles. Similar changes were seen in the brain, the caudate nucleus being seriously involved. The bacteria were Gram-negative but so numerous and small that their shape and dimensions could not be studied in the sections. Although the perimedullary meninges were inflamed, the medulla itself was normal.

Calf No. 12.—Tissue changes were less severe. There was moderate meningeal hyperæmia with hæmorrhages and hæmosiderosis. The brain was actively hyperæmic to the capillary level. In the choroid plexus of the third ventricle were engorged blood vessels, a little hæmorrhage and hæmosiderosis.

Discussion

In Calves Nos. 9 and 10 the disease appears to have been primarily a bacterial meningitis and ependymitis extending into the brain by direct contact and bacterial embolism. All other organs cultured except blood gave negative results; the bacteria in the blood were isolated only after inoculation into broth. There is nothing in our evidence to suggest either pernasal infection *via* the ethmoid bones and olfactory nerves, or umbilical infection. Primary traumatic infection of the meninges can also be ruled out. There is something more definite with Calf No. 12, which showed the typical septicæmia of umbilical origin. The ethmoid route of infection must be considered and infection may have occurred before, during or after birth. Whichever it was, this strain of *Pasteurella septica* seems to have found in the central nervous system a particularly favourable environment—which may account for the difficulty or failure in isolating the organism elsewhere.

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It should be stressed that the cause of death of Calves Nos. 9 and 10 was not explained until the brain and its tunics were examined. While it is not known how frequent are outbreaks of meningo-encephalitis in calves, we feel that the central nervous system is too often neglected at necropsy.

Summary

An outbreak of disease in young calves is reported. Meningo-encephalitis was diagnosed in the three calves available for examination and *Pasteurella septica* isolated in pure culture from each. In one only was infection generalised, and it is suggested that in this one the infection was by the umbilical route. In the other two, the portal of infection is doubtful.

Acknowledgments

To Mr. S. A. Poulton, who took the photomicrographs.

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THE CLIMATIC ENVIRONMENT IN THE MODERN PIGGERY

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It is well known that the pig is physiologically ill-adapted to climatic extremes (Capstick and Wood, 1922; Robinson and Lee, 1941; Newland McMillen and Reineke, 1952); yet in spite of this the majority of pig houses in Great Britain have been so badly constructed, and so little attention given to the fundamental requirements for good thermal insulation and ventilation that they are cold, damp and draughty in the winter, and hot and stuffy in the summer.

Consequently, and directly arising from the unsatisfactory atmospheric conditions that prevail in such piggeries, there have been considerable losses due to low productivity and bad health. The relevant literature contains many references to the need for vigorous research into this aspect of pig husbandry (Post-War Building Studies No. 17, 1945; and No. 22, 1946; Davidson, 1948; Inglis and Robertson, 1949, 1951; Scorgie and Willis, 1952), but so far little scientific work has been carried out.

Inglis and Robertson (1951) made a survey of pig houses in Scotland and found that in a high proportion, poor results were obtained with litters and

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young stores during the winter months. According to their experience, temperature differences between "outside" and "in" were significant for the so-called "bad" and "good" piggeries, the means being 5.9° and 13.3° F. respectively. They obtained evidence which showed that excessive heat loss from the buildings was mostly due to a combination of unnecessarily large air flow through the building, excessive cubic air space per pig, and the absence of effective insulation of the structure. McLagan and Thomson (1950) studied "effective temperatures" (Bedford, 1948) in farrowing houses situated in North-East Scotland, and found that the environment which produced the best pigs had also the highest "effective temperature." These observations confirmed the earlier conclusions of Howie, Biggar, Thomson and Cook (1949), working in the same locality, that it is impossible to rear pigs successfully in "buildings that are cold, draughty and damp."

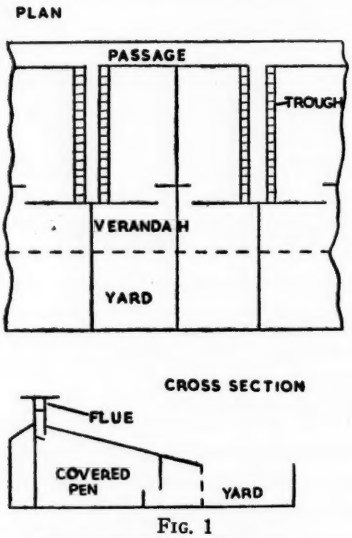

FIG. 1
The "McGuckian" Piggery.

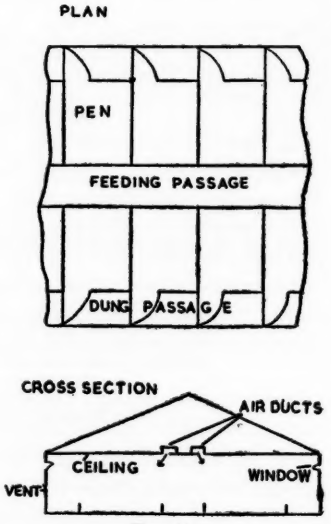

FIG. 2
The "Danish" Piggery.

Deriving from this rather common failure of traditional forms of construction of piggeries, great ingenuity has been displayed of recent years in designing buildings in which pigs can be reared and fattened satisfactorily. The success of some of these newer piggeries warrants a careful examination of their indoor climatic environment, so that from the study of actual observational data, criteria of temperature, humidity, ventilation and thermal insulation can be formulated; such criteria must be satisfactory both from the economic and the animal health and productivity angles.

The object of this paper is to present the results of a climatic investigation carried out during the critical winter months of two modern fattening piggeries. A short description of the piggeries examined is given, the techniques and

apparatus used are indicated and, on the basis of the data presented and discussed, some tentative standards of more general applicability are then formulated.

Description of Piggeries

Two types of pig houses were examined, (see Figs. 1 and 2) one being a totally enclosed building, constructed on the Danish principle with centre feed-passage and side "dunging" passages; the other was of the "McGuckian" design, consisting essentially of a range of well insulated sties leading to partly covered outside yards. Some details of the materials used in their construction together with the thermal transmittance ("U") values* are given in Table I. Both houses were well insulated.

The ventilation of the houses provided an interesting contrast. That of the "McGuckian" house depended on natural means, the fresh air entering the sty through the baffled doorway between the enclosed portion and the yard, and leaving the house through a rectangular insulated chimney with a control flap at its base. The air outlet was limited only by virtue of the baffling in the doorway, which consisted of a baffle wall and sacking curtain.

TABLE I

Forms of construction used in the piggeries and their "U" values.

Surface	Construction	"U" values
Roofs	Outer cladding of asbestos. Inner cladding of insulating boards, with or without a glass fibre quilt. Air space between the two skins.	0.16-0.32
External Walls	11 in. cavity brick.	0.3
Floors	Concrete: incorporating hollow blocks or a lightweight expanded clay aggregate as insulators	Less than 0.2
Windows	Single glass	0.97

The "Danish" house was designed for mechanical ventilation on the plenum, or forced-air, principle. Two centrally placed ducts with a fan at one end were disposed over the central passage above the false ceiling. From these central ducts smaller ducts were led off on either side conveying the air into the piggery through 28 paired openings, each measuring 12 in. x 3 in. Provision was made for air to be re-circulated as desired. The vitiated air left the building through 14 fixed louvred ventilators in the side walls, each measuring 12 in. x 6 in.; and 14 6 in. x 6 in. drainage gratings discharging into closed

*The "U"-value for a construction is the measurement of the amount of heat transmitted through one square foot of the construction from the air inside to the air outside, in one hour when the difference between the air temperatures inside and outside is one degree Fahrenheit.

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external 6 in. earthenware pipes with 8 vents to the external air. Also placed in the walls were 16 hopper-type windows with opening area of 3 ft. x 1 ft. 6 in. each. By virtue of the fact that the fan was installed during the course of the present investigation, it was possible to obtain records with the house naturally ventilated, by the hopper windows and wall ventilators, and later when it was mechanically ventilated by the fan and duct system. Provision was made later still for heating the incoming air when the inside atmospheric temperature fell below 55° F.

Methods

Measurements of the essential climatic elements—temperature, humidity and air velocity—were made, where possible continuous recordings being collected. Air temperatures were recorded using thermographs, maximum and minimum thermometers, or the dry bulb of the whirling hygrometer, whilst surface temperatures were measured using fine, flat-bulbed mercury-in-glass thermometers, after the method of Bedford (1946). Humidities were obtained from hygrographs and the whirling hygrometer, and air velocities with the rotating vane and deflecting vane anemometers, and the kata-thermometer. Rates of air-change were calculated indirectly, after estimating the concentration of carbon dioxide in the atmosphere. For the latter procedure, Haldane's portable CO_2 apparatus was used (Haldane and Graham, 1935); the values for excretion of CO_2 by pigs of different weights were those of Mitchell and Kelly (1938). Windspeeds were obtained at the nearest official meteorological station, situated some six miles away.

Experimental Results

(1) *Temperature:*—Heat is lost from any building by two routes, namely: (a) by conduction of the heat through the structure of the building, and (*b*) by ventilation, when the vitiated and warmed air passes out of the building and cold fresh air flows in to replace it. The heat-loss in British Thermal Units (B.Th.U.) per hour through a structure is equal to:—

The area of the surface x "U" x The temperature difference between the outside and inside air.

The loss by ventilation, also in B.Th.U. per hour is:

The hourly air flow x The specific heat of air (0.019) x The temperature difference between the inside and outside air.

It follows that for any given temperature difference, the calculated heat loss through a structure by conduction will be constant. The ventilation loss, however, presents a far more complex problem since unless the air flow be capable of being accurately controlled, sudden changes will occur in this value due to fluctuations in the weather. Therefore, in order to calculate the theoretical heat loss from a building, the average ventilation rate under "Normal" weather conditions, with the house fully occupied, must first be known.

Table II gives the calculated heat loss by conduction and ventilation for

the two piggeries with a difference of 1° F. between the inside and outside air temperatures. Comparing this with the sensible (i.e., available) heat loss of a pig of average weight in the houses (Mitchell and Kelly, 1938) and assuming each house to be fully stocked, the calculated possible temperature differences between inside and outside are 22° F. in the " Danish " piggery and 33° F. in the " McGuckian." Figs. 3 and 4 give the actual daily minima inside and outside the houses, covering most of the period December to March.

TABLE II

The heat loss from the piggeries and the calculated difference between inside and outside temperatures.

	Heat loss through the surface	Heat loss by air flow	Total heat loss	Average sensible heat production B.Th.U/Pig/Hr.	Calculated possible difference between inside and outside temperatures. Houses fully occupied.
	B.Th.U./Hr./Pig/° F difference between inside and outside temperatures				
" Danish " Piggery	8.7	14.2	22.9	450	20° F.
" McGuckian " Piggery	8.9	6.1	15.0	450	30° F.

Considering the month of January, 1953 (see Fig. 5) which was severe from the point of view of both temperature and wind, the average minimum temperature difference between outside and inside was 21.4° F. in the " Danish " house and 23° F. in the " McGuckian " piggery. Actual minimum temperatures averaged 56.3° F. (Range 50° F. to 64° F.) in the " Danish " piggery, and 57.7° F. (Range 52° F. to 67° F.) in the " McGuckian " piggery. No artificial heating was used in either of the houses during this period.

These figures show fair agreement between the calculated and the actual minimum temperatures. The actual minimum temperature in the " Danish " house was very close to the calculated value (21.4° F. and 20° F. respectively), but the temperature in the " McGuckian " house was 7° F. below the anticipated level of 30° F. Two explanations for this discrepancy can be advanced: (*a*) the house was not fully occupied and so the calculated heat production of the pigs was too high, and (*b*) the total cubic air space in a " McGuckian " unit is small, and the inlet ventilation not easily controllable. Sudden changes in the wind speed or direction would be likely to produce more marked changes in temperatures in the " McGuckian " house than in the " Danish," which by virtue of its much greater total cubic air space, and its fully controllable ventilation, is thus more effectively " buffered " against temperature changes. Moreover, in the " Danish " house, alteration of the ventilation had to be made constantly to keep conditions satisfactory, and this tended to make for less marked differences between inside and outside temperatures.

Diurnal variations of temperature in both houses were relatively small, the average for each being approximately 10° F. through the months of December to March. Differences in temperature at different sites within the piggery at

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any one time were also small, 4° F. being the maximum recorded in the "McGuckian" houses and 6° F. in the "Danish."

The average temperature of the floor's surface taken immediately after the pig had been lying on it was 78° F.; elsewhere in the pen it averaged 68° F. The trunk skin temperature of pigs under winter conditions is stated as being 85° F. (Lee, Colovos and Ritzman, 1941).

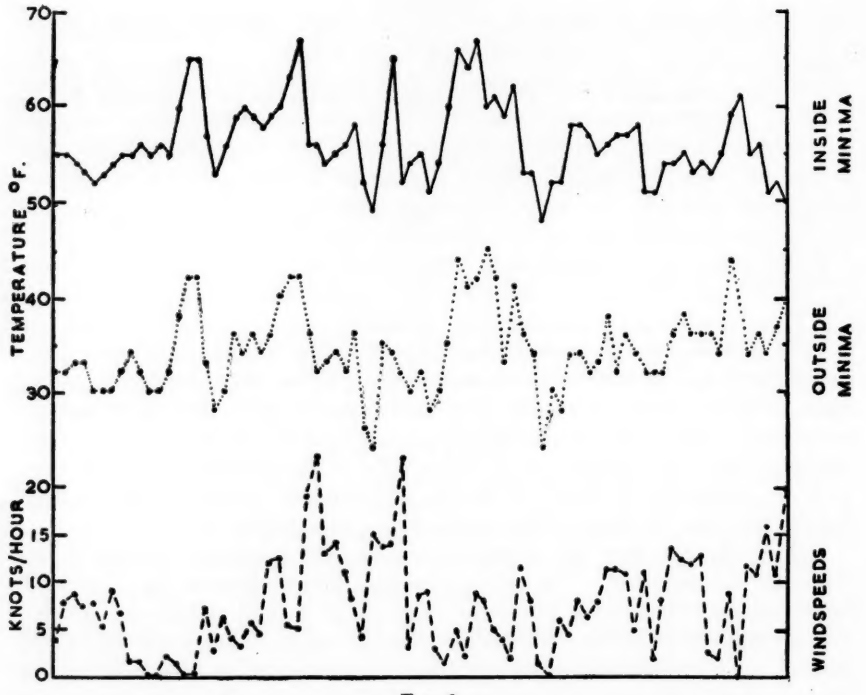

FIG. 3
Nightly minimum temperatures in the "McGuckian" House, January to March, 1953, together with outside minimum temperatures and average windspeeds.
—— Inside Temperature ..... Outside Temperature
- - - - - Windspeeds.

(2) *Humidity:*—The ventilation rate in both houses was controlled so that there was a subjective impression of "freshness" and "dryness," and to prevent the surfaces becoming wet through condensation. With these as the objectives, the relative humidity in both houses was found to average 70 per cent, with little fluctuation either way. The only occasions on which this figure was measurably exceeded was when the floors were seasonally washed down with water. During these short periods the relative humidity approached 90 per

cent. It was found that in the "Danish" house, under natural ventilation only, appreciable condensation took place on the dense concrete rendering of the external walls; ammoniacal odour at the end of the night was strong. These undesirable sequelæ did not occur when the fan was used for ventilating the house.

(3) *The Ventilation and Air Velocities:*—Ventilation must be so balanced that (*a*) a reasonably constant temperature within the comfort range of the pigs is maintained, (*b*) humidity is kept low and condensation prevented, and (*c*) the atmosphere is not polluted by ammoniacal decomposition of fæces and urine. In order to satisfy these requirements, it was found that the average ventilation rates required when the houses were fully occupied were 720 cu. ft. per pig per hour in the "Danish" house, and 300 cu. ft. per pig per hour in the "McGuckian" houses, under winter conditions (outside temperature range 22° F. to 45° F.) (see Table III). This rate was maintained fairly constantly

TABLE III

Cubic air space allowance and fresh air supply.

	Cubic air space/pig (cu. ft.)	Average hourly air supply/pig (cu. ft.)	Ventilation (No. of air changes per hour)
"Danish" Piggery	117	720	6
"McGuckian" Piggery	50	300	6

in the "Danish" house, but in the "McGuckian" piggeries, when weather conditions were very severe (e.g., strong cold winds) the ventilation rate reached 500 cu. ft. per pig per hour. With maximum working of the fan in the "Danish" house, a fresh air supply of 1,400 cu. ft. per pig per hour was possible, and was in fact used on occasion when the weather was particularly mild and humid.

Air velocities in the pens in the region of the pigs' beds fluctuated between 23 and 50 ft./minute in the "McGuckian" house, with an average speed of 30 ft. per minute, and between 20 and 50 ft. with an average of 25 ft. per minute in the "Danish" house under natural ventilation. In the latter, with maximum working of the fan, air entered the house at ceiling level at up to 500 ft./minute, but at the nearest point to its entry in the pen, at 2 ft. 6 in. from the ground, the speed had fallen to 50 ft. per minute.

The considerable fluctuations that occurred in the differences between inside and outside temperatures (see Figs. 3 and 4) suggested that a study of the windspeeds might provide a simple answer to this phenomenon. In Figs.

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3 and 4 the windspeeds are shown together with the nightly minimum temperatures, the mean of the local meteorological station's figures for each night being taken. It is clear that the relation is a complex one, as only on some occasions can the variations in temperature difference be accounted for by a change in the speed of the wind. This is to be expected, as not only were the ventilators controlled in an attempt to maintain constancy of conditions

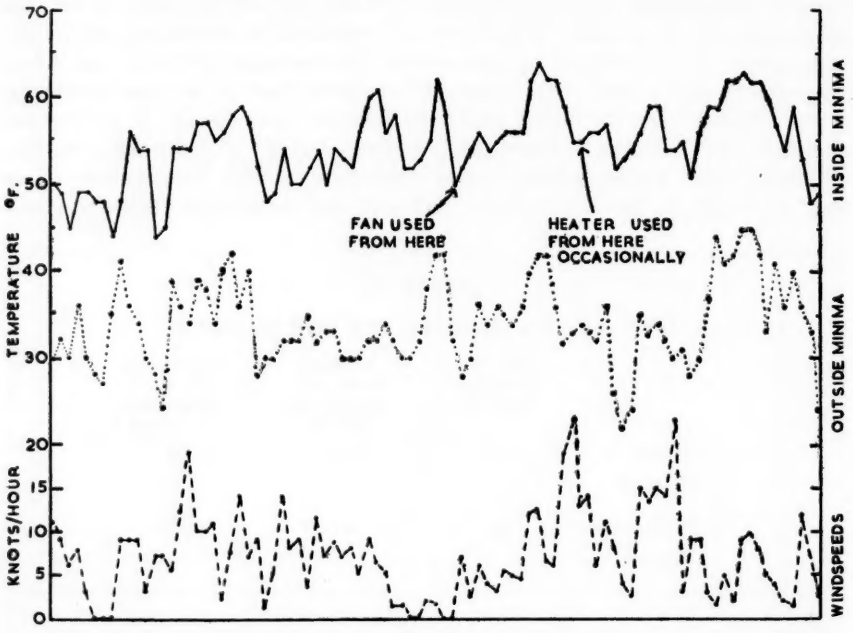

FIG. 4
Nightly minimum temperatures in the "Danish" House, December, 1952, to March, 1953, together with outside minimum temperatures and average windspeeds.
—— Inside Temperature ..... Outside Temperature
----- Windspeeds.

inside the buildings, but no allowance is made for changes in the direction of the wind. However, the continual fluctuation in the windspeed and its clearly frequent effect on temperature differences (see Fig. 6) suggests that it is important to have full control, and if possible, an automatic system of controlling the ventilators so as to minimise the adverse effect of wind as regards temperature stability in the piggeries.

Discussion

The object of controlling the environment within a piggery must be to provide satisfactory conditions in respect of all the climatic elements rather than to provide optimum values for any one of these elements at the expense of the others. Heitman and Hughes (1949) fattened a small number of pigs

in a psychrometric room, and found the optimum temperature to be approximately 75° F. for hogs weighing between 70 and 144 lb., and approximately 60° F. for those between 166 and 260 lb. This standard cannot be considered as wholly satisfactory for commercial fattening houses, since even in well insulated and well ventilated buildings the higher temperatures could only be obtained either by artificially heating the building or by restricting the ventilation to such a degree that conditions would become foul and humid. The approach to the problem made here is in effect the reverse of that made by Heitman and

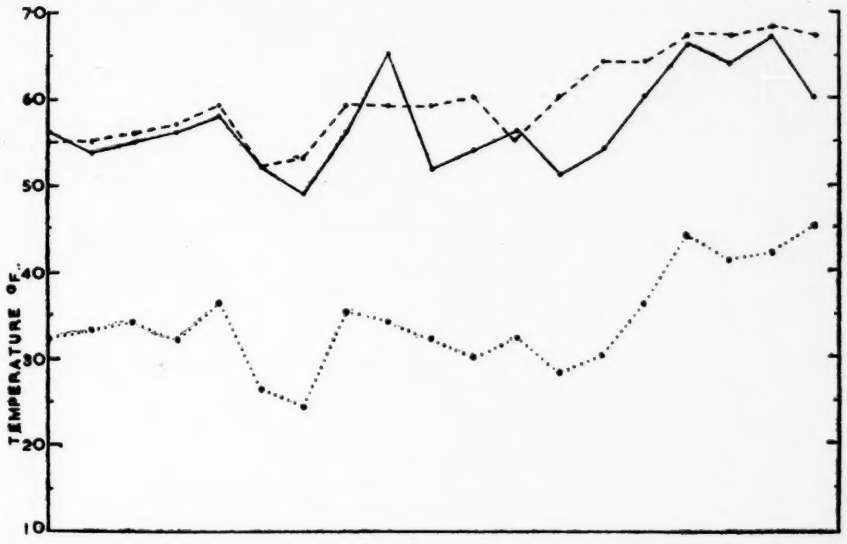

FIG. 5

Nightly minimum air temperatures from January 1 to January 19 inside and outside the piggeries. (No artificial heating or ventilation.)
—— "McGuckian" Piggery ----- "Danish" Piggery
..... Outside Temperature.

Hughes which was purely experimental. Our aim was to study the environment in buildings where the fattening of pigs was being economically carried out, and therefrom to deduce what environmental conditions might be practicable and feasible for more general application.

Most of the standards advised at the present time are based on opinion rather than derived from scientific experiment, though it must be acknowledged that the following authors give more reasoned standards. Thus, Becher and Korsgaard (1951) in Denmark have suggested that it is better to keep the temperature between 50° and 60° F. with a relative humidity of 70 per cent than at 70° F. and relative humidity of 90 to 100 per cent, which recommendations approach closely to the atmospheric conditions obtaining in the two piggeries we have investigated. Dvorak (1951) in an investigation of piggeries

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in Czechoslovakia gives 53 to 59° F. as the optimum temperature range which again approximates to the winter temperatures in our piggeries.

The piggeries which were the subject of our investigation were well insulated, even by standards recommended for human habitations, and, as is shown in Table II, the loss of heat through the structure was small compared with the heat given out by the pigs. Ventilation was also satisfactory, since without producing draughts, it was possible to keep the atmosphere fresh and dry, and prevent undue condensation from forming on surfaces. Therefore, roofs and walls with "U" values of less than 0.3 would appear to be satisfactory. Likewise, floors of the type described, giving a "U" value of under 0.2, provided a well insulated surface for the pigs to lie on.

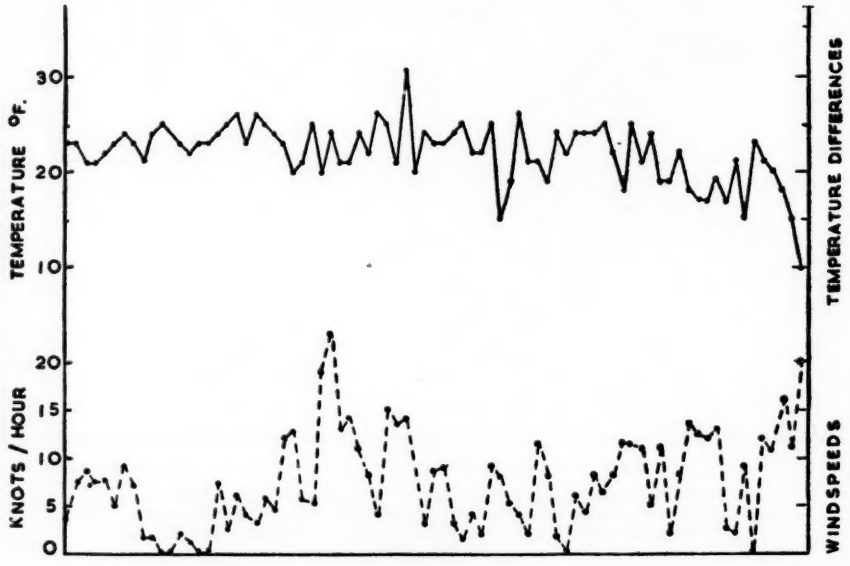

FIG. 6

Graph showing the inverse relationship between windspeeds, and the difference between inside and outside temperatures in the "McGuckian" piggery.

—— Temperature Difference ----- Windspeeds

Throughout the investigation, constant observation indicated that temperature and other environmental conditions were conducive to the comfort and contentment of pigs at all stages of growth. The data here collected prove there is no great difficulty in keeping piggeries at a temperature between 50 and 60° F., and a relative humidity of 70 per cent, provided that the insulation and ventilation are sound. There are good grounds for assuming that, if the houses were kept fully stocked, and more control of the ventilation could be practised—such as could be obtained by the fitting of automatic cut-outs on the inlet

ventilators when the wind blows above a pre-determined speed, the calculated theoretical and the actual values for the temperature difference could be equated. The advantage of the larger building is further exemplified by its ability to buffer the inside temperature when sudden changes take place outside, but, off-setting this, it is relevant to note that in the " McGuckian " piggery conditions were kept almost as constant, but without any ammoniacal odours, and with the added advantage that the environment could be regulated within each pen to suit the small group of pigs contained in it.

The following criteria may be suggested as being satisfactory under winter conditions in houses that are adequately ventilated and insulated :—

(*a*) A difference of from 20 to 30° F. between inside and outside air temperatures.

(*b*) Actual indoor winter temperatures of between 50° F. and 65° F.

(*c*) A relative humidity of approximately 70 per cent.

(*d*) Average ventilation rates of 300 cu. ft. per pig per hour if " dunging " takes place outside the house proper, and 720 cu. ft. with " dunging " inside, and maximum rates of 500 cu. ft. and 1,400 cu. ft. respectively.

(*e*) Air velocities in the pens up to 50 ft./minute, a speed which is barely perceptible to man at temperatures of between 50° to 60° F. (Bedford, 1948).

Summary

Investigations of the winter climatic environment in two modern piggeries in which pigs were being fattened economically are described; one piggery was a completely enclosed building built on the " Danish " principle and the other consisted of insulated sties leading to partly covered yards, this being the so-called " McGuckian " design. Both buildings were well insulated and ventilated.

The observations made showed that :

(*i*) Temperatures from 50° F. to 65° F., and a relative humidity of 70 per cent was easily maintained without heating the buildings artificially.

(*ii*) Average ventilation rates of 300 cu. ft. per pig per hour in the " McGuckian " piggery and 720 cu. ft. per pig per hour in the " Danish " house, enabled atmospheric conditions to be kept satisfactory.

(*iii*) Materials with " U " values of 0.3, or less, provided good thermal insulation.

(*iv*) The windspeed had a definite and sometimes pronounced effect on the difference between inside and outside temperatures.

Acknowledgments

We wish to acknowledge the valuable help given to us throughout the course of this investigation, by Professors N. J. Scorgie and M. M. Cooper.

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OBSERVATIONS ON THE USE OF ADRENOCORTICOTROPHIC HORMONE AND ADRENAL CORTICAL EXTRACT IN TUBERCULOSIS IN THE PIG

A Note on the Effects of These Preparations on the Tuberculin Skin Sensitivity

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EVIDENCE is accumulating that the uses of these preparations may intensify the spread of infection in tuberculosis. Spain and Molomut (1950) reported that, in guinea pigs and rabbits suffering from tuberculosis, treatment with adrenal cortical extract caused widespread and extensive lesions. Hart and Rees 1950) recorded that the course of chronic pulmonary tuberculosis of mice, was much altered for the worse by treatment with adrenal cortical extracts. In the treatment of human affections apart from tuberculosis there is evidence that suggests a causal relationship between the exacerbation of tuberculosis and the administration of adrenal cortical extracts. The ability of these hormones to desensitise the skin in some animals has been reported. Harris and Harris (1950) found that adrenal cortical extracts in guinea pigs and rabbits, sensitised to the tubercle bacillus, suppressed the skin reaction to old tuberculin and Long and Favour (1950) found that ACTH obliterated the PPD reaction in 13 out of 34 infected human beings.

The Effect of Adrenocorticotrophic Hormone and Adrenal Cortical Extract on the course of Tuberculosis in the Pig

Four pigs, X.27, X.28, X.32 and X.34 were injected intraperitoneally with ½ ml. suspension of bovine tubercle bacilli. (This method of sensitising the pig to the tubercle bacillus was adopted as a standard technique in extensive experiments involving a large number of pigs. In a series of 57 pigs infected in this manner only 2 showed evidence of subsequent generalisation between 5 and 6½ months after infection). Fifteen days later they were tested and all showed a measure of sensitivity. No. X.27 weighing 48 lb. was given a course of ACTH; a daily dose of 50 mg. was given in two equal portions—at 9.30 a.m. and at 5.30 p.m. The drug was administered over a period of five days. Pig No. X.34 received adrenal cortical extract for a similar period. This pig weighed 46 lb. and it received 100 mg. of the extract daily. The two other pigs, Nos. X.28 and X.32, were kept as controls. The pigs were weighed at intervals during the experiment and total white cell and differential white cell counts were made daily during the course of treatment and at intervals afterwards.

During the five days in which the drug was administered pig No. X.27 (receiving adrenocorticotrophic hormone) lost 7 lb. in weight while pig No. X.34, which received the adrenal cortical extract, lost 3 lb. The two control pigs gained 6 lb. and 5 lb. respectively over the same period. Pig No. X.27

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continued to lose weight, developed a cough and died 21 days later. This pig weighed 48 lb. at the beginning of the experiment, and at its death 26 days later its weight was only 27½ lb. Post-mortem examination showed extensive generalised tuberculosis involving the liver, spleen, mesentery and omentum, the peritoneal surface of the stomach, large intestine and cæcum; miliary lesions were found in both lungs and infection was present in all the carcase lymph glands. Pig No. X.34 also continued to lose weight though in this case the loss of weight was not so spectacular as with No. X.27. It was killed 28 days after the beginning of the experiment, during which time its weight fell from 46 to 40 lb. The post-mortem examination showed extensive generalised tuberculosis similar to that recorded in No. X.27. The two control pigs continued to gain weight and at the end of the experiment had gained respectively 25 and 26 lb in weight.

The total white cell count increased in both treated pigs. This count remained higher than normal in both pigs to the end of the experiment. At the same time there was a sharp increase in polymorphs and a decrease in the absolute number of lymphocytes. This persisted during treatment with the drug, and thereafter there was some fluctuation in both the polymorph and lymphocyte numbers though the total white cell count remained high.

The results leave little doubt as to the adverse effect which the two preparations had on the course of the disease in the experimental pigs. The loss of weight of the pig receiving ACTH was especially noteworthy, and although the weight loss shown by the pig receiving cortisone was not so marked yet the disease advanced to a spectacular degree in both pigs. The ACTH may have had some slight desensitising effect on the skin reaction as is shown in Table II, but the rapid advance of the disease process may in itself have caused this depression in sensitivity. The cortisone had no depressing effect on the skin test.

The two control pigs Nos. X.28 and X.32 continued to thrive and they were slaughtered eighteen weeks after the termination of the experiment. Post-mortem examination of X.28 showed the presence of lesions of tuberculosis on the peritoneum, pea-sized lesions on the omentum, lesions in the liver and spleen and evidence of the disease in all the carcase lymph glands. The disease was classified as generalised and the whole carcase condemned. Over the period from the beginning of the experiment up to slaughter this pig showed an average weight gain of 1.3 lb. per day. Post-mortem examination of X.32 also showed evidence of generalised tuberculosis. This pig showed an average daily weight gain of 1.14 lb. These weight gains can be regarded as very satisfactory apart from any consideration of the concomitant disease process and these present examples supply further evidence of the considerable tolerance of the normal pig to the presence of even widespread tuberculosis. It is common experiencce during routine meat inspection to find pig carcases which on superficial examination appear to be healthy and of first class quality but on detailed examination reveal lesions of such an extent as to merit total condemnation under present-day meat inspection regulations.

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In view of the results in the experiment in pigs where there was an existing sensitivity it was decided to repeat the experiment and to give a course of the hormone commencing at the time of infection and therefore before any hypersensitivity had developed. The dosage was the same.

Eight pigs were infected in the usual manner; four were given a four-day course of the adrenocorticotrophic hormone commencing at the same time as the tubercle bacilli (bovine type) were given and the other four were kept as controls. Blood counts were made during the course of treatment and a measure of lymphopenia was maintained. The pigs were weighed at intervals and judged by the appearance and weight gains, there was little difference up to a month between the treated group and the controls. At this stage the eight were tested and a fair measure of sensitivity was present in each. A further course of the hormone was then given and in view of the observations of Kerr (1952) that a reduced dose given intradermally could elicit a blood reaction in cattle it was decided to inoculate it intradermally. The pigs were treated as follows:— One of the experimental pigs and one of the controls, were given the hormone, the dose being calculated as 1 mg. per lb. body weight. Three pigs weighing respectively 42, 62, and 70 lb. were given a course of the hormone consisting of 5 mg., 10 mg. and 15 mg. doses intradermally twice daily. This was continued for four days and at all dosage levels a satisfactory blood response was seen.

There was no dramatic response and it was impossible to differentiate clinically between the treated and the control pigs. All the pigs were killed one month after the commencement of the second experiment and careful post-mortem examinations made. Assessment of the results presented some difficulty and a system of scoring was decided upon. The extent of infection present in seven situations was recorded, and the degree of tuberculosis was classified as very heavy, heavy, fairly heavy, light or negative. These degrees were scored as 4, 3, 2, 1 and 0 respectively and the situations chosen for assessment were: the peritoneal surface of the colon, the peritoneal surface of the cæcum, the omentum, the spleen, the liver, the peritoneal surface of the diaphragm and the lungs. They were chosen because of the intraperitoneal route of infection. The amounts of the drug given and the pathological scores are summarised in Table I.

From this table it will be seen that the two control pigs Nos. X.92 and X.94 scored the lowest marks with the exception of X.95. Post-mortem examination of this animal showed no macroscopic lesions of tuberculosis though a high degree of skin sensitivity was present before slaughter. Otherwise the pathological score follows very closely the amounts of the hormone administered. While these present results lacked the dramatic conclusion of the earlier experiment they do suggest tvhat the adrenocorticotrophic hormone hindered the localisation of the disease.

The Effect of Adrenal Cortical Extract and Adrenocorticotrophic Hormone on Skin Sensitivity in the Pig

Some limited observations were made on the effect of these preparations

on skin sensitivity of pigs infected with the bovine type of tubercle bacillus. One pig weighing 48 lb. received a five-day course of adrenocorticotrophic hormone. The daily dose was 50 mg. Before the administration of the drug the test gave a skin reaction of 10.5 mm., whereas a skin reaction of 7.5 mm. was elicited at a different site four days after treatment had begun. Seven days later a further test evoked a rise of 4 mm. only. A second pig weighing 46 lb. was given a five-day course of cortical extract (100 mg. per day). Prior to administering the drug the skin test was 18.5 mm. Four days later a second test showed a reaction of 22.5 mm. and seven days later a third test produced a skin reaction of 22 mm.

TABLE I.

The Administration of Adrenocorticotrophic Hormone and the Spread of Tuberculosis

Pig No.	Initial course at time of infection	Second course when skin sensitivity present	Pathological score
X.88	1 mg. per lb. intram.	1 mg. per lb. intram.	22
X.89	1 mg. per lb. intram.	5 mg. intrad.	14
X.90	1 mg. per lb. intram.	10 mg. intrad.	15
X.91	1 mg. per lb. intram.	Control	11
X.92	Control	Control	3
X.93	Control	15 mg. intrad.	9
X.94	Control	Control	6
X.95	Control	1 mg. per lb. intram.	0

Intram = Intramuscular. Intrad. = Intradermal.

Some desensitising effect appears to be evident in the pig receiving the adrenocorticotrophic hormone but in view of the fact that rapid generalisation of the disease was taking place the disease process itself may have contributed to the drop in sensitivity. The cortical extract had no apparent effect on the skin reaction and although generalisation was also developing in this pig, skin sensitivity remained at a high level.

TABLE II.

Pig No.	Increase in skin measurement in mm. At first test	At 3 day test	At 11 day test
X.27 (ACTH)	10.5	7.5	4
X.34 (Cortisone)	18.5	22.5	22
X.28 (Control)	19.0	18.5	23
X.32 (Control)	17.5	21.0	21.5

The effect of the adrenocorticotrophic hormone on skin sensitivity was examined further in another group of eight pigs. These pigs had been sensitised in the usual way and all showed a satisfactory measure of skin sensitivity before receiving a four-day course of the drug. Further tests were made during and after treatment. In no instance was there any evidence that

the drug had a depressing effect on the skin sensitivity. In this group generalisation was not developing as rapidly as in the pigs discussed earlier.

The effect of the adrenocorticotrophic hormone injected locally at the site of a tuberculin test was also examined. In one pig 4 mg. of the hormone was injected into the test site one hour before the injection of tuberculin. A second site was injected with tuberculin for comparative purposes. The skin reaction at the hormone injected site was 23.5 mm. whereas the reaction at the control site was 25 mm. The control site was at its peak in 24 hours whereas at the hormone injected site the peak reaction was only reached at 48 hours. A second pig was injected with 6.5 mg. of the hormone and one hour later it was tested in the same way. In this case the hormone site reaction was 13 mm. and was at its peak in 24 hours. The control site reaction was 20.5 mm. and it too, was at its peak at 24 hours.

These results suggest that the hormone interfered with the development of the local reaction; in one case there was a delay in the reaction reaching its peak and in the other a desensitising effect was observed. In the pigs where the hormone was injected at a site remote from the tuberculin test site there was no evidence that the resultant lymphopenia had any effect on the skin reaction.

Summary

The use of adrenocorticotrophic hormone and adrenal cortical extract in established tuberculosis in the pig appeared to enhance susceptibility and favour generalisation of the disease. The parenteral administration of these preparations did not have any effect on the local skin reaction induced by the intradermal injection of tuberculin. When used locally at the test site there was some evidence that the hormone interfered with the full expression of the skin reaction.

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THE RESULTS OF AUTOPSIES ON TRYPANOSOME-INFECTED CATTLE

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Introduction

FIENNES (1953) has described experiments to maintain cattle in a tsetse infested area at Kiboko, in Kenya, using antrycide and dimidium as prophylactics. At the close of these experiments, surviving cattle were killed and immediate autopsy was performed. The present paper gives an account of the condition of these cattle post-mortem; their history will be found in the paper under reference. In addition, the condition post-mortem of control cattle sent to the same area, but not drug protected, is given.

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Animals were killed by shooting in the brain, and the vessels of the neck were then severed.

Antrycide Protected Cattle at Kiboko

No. 5834

General.—External appearance was normal and condition good. The fat and subcutaneous tissues appeared normal. There was a considerable quantity of peritoneal fluid, clear and of a straw colour.

Lymphatic Glands.—All were enlarged, pale and œdematous. In both prescapular and precrural glands there were hæmorrhagic spots in the medulla.

Hæmolymph System.—A few hæmolymph glands were present subcutaneously in the region of the shoulder. There were small hæmolymph glands attached to both prescapular and precrural glands. Hæmolymph glands were also attached to both adrenals; a number of others lay dorsal to the kidneys and were attached to them. There were a few small nodes in the portal region of the liver. There were clusters of enlarged glands lying along the dorsal surface of the trachea.

Spleen.—This organ was very much enlarged. The surface was uneven due to congestion of the blood vessels. It was bluish in colour, the dark pulp shining through the opaque capsule. When cut the pulp was semi-fluid and dark chocolate in colour and it overlapped the cut edges. The Billroth cords were reddish in colour and much enlarged.

Kidneys.—The surface was mottled and had a nutmeg appearance. The cut surface appeared normal. One kidney had a small abscess full of yellowish pus.

Liver.—This organ was enlarged and swollen. The edges were rounded. The surface was slightly nodular. The colour and appearance of the parenchyma was normal, but there was some cirrhosis due to liver fluke.

Lung.—There were a few calcified nodules filled with yellow material. There was also a large cyst filled with fluid. The lung tissues appeared normal but the trabeculæ were thickened.

Heart.—This was very flabby and the right side was dilated. The surface had a marbled appearance. When held up it tended to drip with excess of red serous fluid.

Bone Marrow.—This was normal in the sternum, ribs and vertebræ. All red marrow in the long bones had been replaced by yellow.

No. 5913

General.—External appearance was normal and condition good. Fat and subcutaneous tissues were normal. There was an excess of peritoneal fluid.

Lymphatic Glands.—Both prescapular glands were enlarged, œdematous, fibrous and pale in colour; there was a line of black pigmentation beneath the capsule. The precrural glands showed the cortex pale, but the medulla hæmorrhagic. These, too, showed a pigmented line beneath the capsule. Hepatic glands were enlarged, œdematous and fibrous.

Hæmolymph System.—There was a hæmolymph gland attached to a precrural gland. The glands were not especially numerous but were much enlarged along the gastro-intestinal tract. Along the trachea also they were few but enlarged.

Spleen.—This organ was much enlarged and showed the same appearance as No. 5834.

Kidneys.—The surface of both organs was pale and mottled and showed irregular pitting. The colour of the cut surface was slightly pale and similar in both cortex and medulla.

Liver.—The organ was swollen and had rounded edges. The colour was normal. The surface was scarred. It cut as if fibrous.

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Lungs.—The lungs appeared shrunken. The trabeculæ were enlarged and lymphatics were corded.

Heart.—This was pale in colour and the muscle was very flabby. When held up, excess serous fluid dripped from it.

Bone Marrow.—This was red in sternum, ribs and vertebræ. All red marrow in the long bones had been replaced by yellow.

No. 5879

General.—External appearance was normal and condition good. The fat was yellowish and moist in appearance. There was excess peritoneal fluid.

Lymphatic Glands.—Both prescapular and precrural glands were enlarged, œdematous and fibrous, with small hæmorrhagic patches in the medulla. The glands were enlarged throughout the body.

Hæmolymph System.—There was a small hæmolymph gland attached to one precrural gland. Along the trachea they were very numerous and much enlarged.

Spleen.—This was considerably enlarged and similar to those of the two previous animals.

Kidneys.—Both organs appeared shrunken. Their surfaces were mottled. On section the cortex was seen to be pale in colour and the medulla dark and full of blood.

Liver.—This organ was shrunken and the edges were sharp. It was pale in colour. The surface showed considerable scarring, and there were some depressions associated with subcapsular hæmorrhagic areas. Some of the bile ducts were stained yellow.

Lungs.—Normal in appearance.

Heart.—The muscle was very flabby. When held up red-stained fluid dripped from it.

Bone Marrow.—This was red in the sternum, ribs and vertebræ. In the long bones the red marrow had been replaced by yellow.

No. 5906

General.—This animal was small, thin and emaciated. Fat and subcutaneous tissues were normal. There was an excess of peritoneal fluid.

Lymphatic Glands.—These glands throughout the body were pale, enlarged, œdematous and fibrotic.

Hæmolymph Glands.—Enlarged hæmolymph glands were attached to both prescapular glands. They were numerous at the hilus of the kidneys. One large gland was present in the pericardium attached to the aorta. They were not numerous along the course of the trachea.

Spleen.—This was much enlarged, presenting the same picture as in the previously-mentioned cattle.

Kidneys.—Both organs showed the surface mottled and the tissues pale in colour.

Liver.—The organ was much swollen and enlarged and the edges rounded. The colour was normal.

Lungs.—The lungs were pale in colour and appeared to be shrunken.

Heart.—The muscle was pale and very flabby.

Bone Marrow.—Not examined.

No. 5832

General.—The condition was very poor and the animal had the typical appearance of being "fly struck." Fat and subcutaneous tissue appeared normal.

Lymphatic Glands.—All were enlarged, pale, œdematous and fibrous.

Hæmolymph System.—There were hæmolymph glands attached to both

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prescapular glands. They were also found on the surface of the rumen and in the intestinal mesentery. Around the kidney they were very numerous, also along the course of the trachea, where they were much enlarged.

Spleen.—This was much enlarged and presented the same picture as already described.

Kidneys.—The kidneys were mottled on the surface and had a nutmeg appearance. There were some depressions of the surface. The cortex was pale and yellowish, but the medulla dark and full of blood.

Liver.—This was slightly enlarged and had rounded edges. The surface was scarred. The colour was normal, but on section it appeared to be fibrous.

Lungs.—These were flabby and shrunken. There were many whitish patches, which appeared to be fibrous tissue. The trabeculæ were thickened.

Heart.—The muscle was very flabby. When held up red-stained serous fluid dripped from it.

Bone Marrow.—The marrow was red in the sternum, vertebræ and ribs. In the long bones red marrow had been replaced by yellow.

Additional Antrycide Protected Cattle at Kiboko

Histories of the following three cattle were not included in the work (Fiennes, 1953) under reference :—

No. 007

History.—Received 10 c.c. of 20 per cent antrycide dichloride on 17/9/49. Sent to Kiboko 6/10/49. *T. vivax* positive 22/11/49. *T. congolense* positive 16/12/49. Hæmoglobin, 8/3/50, 50 per cent; 23/3/50, 50 per cent. Killed, 4/4/50.

General.—Condition fair, but rather thin. Fat and subcutaneous tissues normal, but there was a small amount of myxomatous fat in the region of the scapula. There was a slight excess of peritoneal fluid.

Lymphatic Glands.—Pale, enlarged, œdematous and tending to be fibrous. There were hæmorrhagic patches in the medullas of some of them.

Hæmolymph System.—There was a much-enlarged hæmolymph gland attached to the adrenal. Along the course of the trachea were numerous glands, much enlarged.

Spleen.—This was much enlarged and showed the same appearance as with the preceding animals.

Kidneys.—The surface was mottled with light and dark areas. The cut surface showed no obvious abnormalities.

Liver.—The surface was scarred. The colour was dark purple, and there was considerable congestion. The edges were thickened. It cut as if fibrous.

Lungs.—Some parts showed atelectasis. In general the organ was congested.

Heart.—The superficial vessels were congested and there was one sub-epicardial hæmorrhage. In colour, the muscle was of a pinkish tinge.

Bone Marrow.—Not examined.

No. 043

History.—Received 10 c.c. of 20 per cent antrycide dichloride on 10/10/49. Sent to Kiboko 18/10/49. *T. vivax* positive 28/11/49. *T. congolense* positive 12/12/49. Hæmoglobin, 14/2/50, 45 per cent; 8/3/50, 50 per cent; 23/3/50, 45 per cent. Killed on 9/5/50.

General.—This animal was thin and emaciated and had a "fly struck" appearance. There was a slight excess of peritoneal fluid.

Lymphatic Glands.—These were enlarged, pale, œdematous and fibrotic throughout.

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Hæmolymph System.—These glands were not very numerous. Those found were enlarged.

Spleen.—This was enlarged and showed the same appearance as in the previous case.

Kidneys.—They were slightly pale and mottled, otherwise they appeared normal.

Liver.—This organ was very enlarged and swollen and had thickened edges. The colour was normal. It cut as if fibrous.

Lung.—This was slightly œdematous. The trabeculæ were thickened.

Heart.—The muscle was very flabby and serous fluid dripped from it.

Bone Marrow.—Not examined.

No. 049

History.—Received 10 c.c. of 20 per cent Antrycide dichloride on 10/10/49. Sent to Kiboko on 18/10/49. *T. vivax* positive 7/12/49. Never showed positive blood or gland smears for *T. congolense.* Hæmoglobin, 14/2/50, 50 per cent; 8/3/50, 50 per cent; 23/3/50, 50 per cent. Killed, 4/4/50.

General.—Condition was fair. There was some myxomatous fat. Subcutaneous tissues were normal. There was excess of peritoneal fluid.

Lmphatic Glands.—These were enlarged, pale, œdematous and fibrosed.

Hæmolymph System.—These glands were scanty and not enlarged.

Spleen.—The organ was very much enlarged and showed the same appearance as previous cases.

Kidneys.—The cortex of both kidneys was slightly congested; the medulla was very congested and hæmorrhagic.

Liver.—This was much enlarged and swollen; the edges were rounded; it cut as if fibrous.

Lung.—There were small areas of red hepatisation, but these floated in water. The trabeculæ were thickened.

Heart.—The muscle was very flabby and the blood vessels were congested.

Bone Marrow.—Not examined.

Dimidium Protected Cattle at Kiboko

Histories of these cattle have been given by Fiennes (1953).

No. 6266

General.—Appearance was normal and condition good. Fat and subcutaneous tissues were normal. There was an excess of peritoneal fluid.

Lymphatic Glands.—These were enlarged, pale, œdematous and fibrous. A few were slightly hæmorrhagic in the medulla.

Hæmolymph System.—Glands were very numerous and much enlarged over the stomachs and along the course of the trachea.

Spleen.—The spleen was moderately enlarged and otherwise showed the same appearance as in the antrycide protected groups at Kiboko.

Kidneys.—There was diffuse scarring and mottling of the surface. The cut surface appeared normal.

Liver.—This organ was much enlarged and swollen. The edges were rounded. The surface was slightly scarred. The colour was dark. It cut as if fibrous.

Lungs.—These were shrunken and atrophic. The trabeculæ were thickened.

Heart.—The muscle was very flabby and the organ dripped red serous fluid.

Bone Marrow.—Red in sternum, ribs and vertebræ. Yellow in long bones.

No. 6276

General.—A good, strong bullock, apparently in very good condition. Fat and subcutaneous tissues normal. No excess of peritoneal fluid.

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Lymphatic Glands.—The prescapular and precrural glands were not so much enlarged as usual. They were œdematous and fibrous. The cortex was pale but the medulla was dark. There was a very enlarged duodenal lymphatic gland, which was œdematous and hæmorrhagic. The renal lymphatic glands were much enlarged.

Hæmolymph System.—There was a gland attached to the left adrenal. There were two very large glands along the course of the trachea.

Spleen.—The spleen was much enlarged and showed the same appearance as in the other cattle at Kiboko.

Kidneys.—The surface was mottled and scarred. The cortex was pale but the medulla was red in colour.

Liver.—This was slightly swollen. It was normal in colour. There were a few depressions on the surface. It cut as if fibrous.

Lungs.—These appeared shrunken and atrophic.

Heart.—There were a number of small sub-epicardial hæmorrhages. The muscle was pale and flabby. Red-stained serous fluid dripped from it.

Bone Marrow.—This was red in sternum, ribs and vertebræ, but yellow in the long bones.

No. 6281

General.—This animal appeared to be in good general condition, though slightly unthrifty. Subcutaneous tissues and fat were normal. There was considerable excess peritoneal fluid.

Lymphatic Glands.—The prescapular glands were enlarged, pale, œdematous and fibrous. The precrural glands were similar to the prescapular, but each gland had four large hæmolymph glands embedded in the medulla. These had separate capsules and the tissue was distinct.

Hæmolymph System.—Glands were embedded in the precrural glands as described above. Glands were numerous and enlarged around the stomachs and also along the course of the trachea.

Spleen.—This was very much enlarged and showed the same appearance as in the previous Kiboko cases.

Kidneys.—The surface was irregularly mottled and scarred. The cortex was pale and the medulla red.

Liver.—This was enlarged, but the edges were sharp. The colour was normal. There was some superficial scarring. It cut as if fibrous.

Lungs.—These were flabby and shrunken in appearance. The trabeculæ were thickened.

Heart.—The muscle was flabby and it dripped a red-stained serous fluid.

Bone Marrow.—This was red in sternum, ribs and vertebræ, but yellow in the long bones.

No. 6297

General.—Condition good. Subcutaneous tissues and fat were normal. There was excess of peritoneal fluid.

Lymphatic Glands.—Prescapular and precrural glands were enormously enlarged, pale, œdematous and fibrous. The hepatic lymph gland was much enlarged.

Hæmolymph System.—There were a few nodules throughout the gastro-intestinal tract. Along the trachea were a number of glands, only three of which were abnormally large.

Spleen.—This was very much enlarged and showed the same appearance as in other Kiboko cases.

Kidneys.—The surface was pale and mottled, but there was no scarring or pitting. The cortex was pale and the medulla red.

Liver.—The liver was enlarged and swollen, with rounded edges. The surface was irregular and scarred. The colour was dark. It cut as if fibrous.

Lungs.—These appeared shrunken. The trabeculæ were thickened.

Heart.—The muscle was pale and flabby. Red-stained serous fluid dripped from it.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ, but yellow in the long bones.

No. 6302

General.—Thin, emaciated and "fly struck" in appearance. There was some myxomatous change of the subcutaneous fat. There was excess peritoneal fluid. There were extensive pleural and peritoneal adhesions.

Lymphatic Glands.—These were enlarged, pale, œdematous and fibrous throughout.

Hæmolymph System.—There were large glands attached to the adrenals. They were numerous along the course of the trachea, and in the mediastinum.

Spleen.—This was much enlarged and showed the usual appearance. It was adherent to the body wall.

Kidneys.—The surface was slightly mottled, but otherwise these organs appeared to be normal.

Liver.—There were adhesions between the liver and diaphragm. The organ was much enlarged and swollen and had rounded edges. The colour was normal. There was a calcified lesion in the portal region, which appeared to contain a concentration of dimidium. It cut as if fibrous.

Lungs.—These appeared atrophic. There was slight œdema. The trabeculæ were thickened.

Heart.—The muscle was flabby and pale. Red-stained serous fluid dripped from it.

No. 6250

General.—In appearance a normal, healthy ox, fat and in good condition. Subcutaneous tissue and fat were normal.

Lymphatic Glands.—These were less enlarged than usual, but appeared œdematous and fibrous. The precrural glands showed a rim of black pigmentation under the capsule.

Hæmolymph System.—There was a large gland attached to one precrural gland. Glands were numerous along the course of the trachea.

Spleen.—This was much enlarged and showed the usual appearance.

Kidneys.—The surface was slightly mottled. Otherwise they appeared to be normal.

Liver.—This was very much enlarged and swollen. The edges were sharp. The surface showed considerable scarring. The pulp was dark in colour. It cut as if fibrous.

Lungs.—Normal in appearance.

Heart.—The muscle was flabby. Red-stained serous fluid dripped from it.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ, but yellow in the long bones.

Untreated Cattle Sent to Kiboko

The following cattle were sent to the "fly" area and killed for autopsy at a time when they were unlikely to survive.

XUM

No. 110

History.—31/10/50 sent to Kiboko. 23/11/50 *T. vivax* positive. Killed on 28/11/50.

General.—Thin and "fly struck." Fat and subcutaneous tissues normal. No excess of peritoneal fluid.

Lymphatic Glands.—These were enlarged and œdematous; pale in colour. Both prescapular and precrural glands showed a band of black pigment below the capsule.

Hæmolymph System.—There were a few enlarged glands subcutaneously.

Spleen.—Much enlarged with a few subcapsular hæmorrhages. Otherwise appearances were similar to the protected cattle at Kiboko.

Kidneys.—These were slightly pale with the surface mottled. The cut surface appeared normal, but there were hæmorrhages into the calyces.

Liver.—This was normal in size. It was pale in colour. The edges were sharp.

Lungs.—These appeared somewhat collapsed, but the cut surface was hæmorrhagic.

Heart.—There were a few sub-epicardial hæmorrhages. The muscle was flabby.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ, but yellow in the long bones.

No. 479

History.—3/10/50 sent to Kiboko. 11/10/50 *T. vivax* positive. 30/10/50 killed for autopsy.

General.—Thin and very weak. Fat and subcutaneous tissues normal. No excess peritoneal fluid.

Lymphatic Glands.—These were much enlarged, pale in colour and œdematous.

Hæmolymph System.—There was no hyperplasia.

Spleen.—This was much enlarged, and had the same appearance as No. 110.

Kidneys.—These organs were shrunken and pale in colour. There were hæmorrhages between the cortex and medulla.

Liver.—This was small with sharp edges. It was pale in colour and stained with bile.

Lungs.—Normal.

Heart.—This was externally covered with sub-epicardial hæmorrhages. There were a few sub-endocardial hæmorrhages in the right ventricle. The muscle appeared pink and hæmorrhagic.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ, but yellow in the long bones.

No. 255

History.—28/8/50 sent to Kiboko. 15/9/50 *T. vivax* positive. 3/10/50 killed for autopsy.

General.—Thin and "fly struck." The subcutaneous tissues were normal but some of the fat was slightly myxomatous. There was excess peritoneal fluid.

Lymphatic Glands.—These were much enlarged and œdematous. Some of the abdominal glands appeared to consist partly of hæmolymph tissue.

Hæmolymph System.—There was no hyperplasia of the glands, but there were a number of very small glands along the course of the trachea.

Spleen.—This was very much enlarged with appearance as in No. 110.

Kidneys.—These were pale in colour, otherwise normal.

Liver.—This was light in colour. It was otherwise normal with sharp edges.

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Lungs.—These were normal, but congested.

Heart.—There were numerous sub-epicardial hæmorrhages.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ. In the long bones red marrow had disappeared from the epiphyses,, but some was found in the centre of the shaft.

No. 227

History.—28/8/50 sent to Kiboko. 18/9/50 *T. vivax* positive. 3/10/50 killed for autopsy.

General.—Thin and "fly struck." Fat and subcutaneous tissues normal. Excess peritoneal fluid.

Lymphatic Glands.—These ware pale, enlarged and œdematous. Some contained a few hæmorrhagic spots.

Hæmolymph System.—There was no general hyperplasia, but small glands the size of a millet or sorghum seed were numerous.

Spleen.—This was very much enlarged and presented the usual picture.

Kidneys.—These were paler than normal. The cortex was ischæmic, but the medulla hæmorrhagic; the hæmorrhages extended into the calyces.

Liver.—This was slightly pale in colour. Otherwise it appeared normal and the edges were sharp.

Lungs.—These appeared shrunken. They were otherwise normal.

Heart.—There were sub-epicardial hæmorrhages splashed over the entire surface. There were also a few sub-endocardial hæmorrhages.

Bone Marrow.—The marrow was red in sternum, ribs and vertebræ, but yellow in the long bones.

Discussion

All cattle used in these experiments were adult Zebu bulls or bullocks, except Nos. 007, 043 and 049, which were Guernseys. Results should be read in conjunction with Charts I and II of the paper under reference (Fiennes, 1953), which gives the histories of the cattle.

Results show a definite and characteristic syndrome associated with a form of trypanosome infection described by Fiennes (1950), where either antrycide or dimidium was used to control it. The post-mortem picture of experimental trypanosomiasis in both the acute and chronic stages was described by Fiennes, Jones and Laws (1946) and literature on the subject was extensively reviewed. The pathology of normal trypanosomiasis is not constant or characteristic, thus differing from the causes reported here.

It is especially noteworthy that in the post-critical stages of trypanosomiasis the spleen becomes normal or even reduced in size. Where survival is maintained by drugs, under conditions of reinfection, there is a constant and characteristic splenomegaly.

No signs of generalised œdema were seen in these cases, but in most animals there was an excess of peritoneal fluid. There were signs of lesions of the heart, together with evidence of hepatic and renal involvement. In the liver there was enlargement, swelling, and rounded edges, without congestion, indicating cloudy swelling. The surface was often scarred and the tissue cut as if fibrous; hence an incipient chronic fibrosis is to be suspected. In the kidneys there were also signs of scarring, and a chronic degeneration is to be suspected. Congestion and hæmorrhages are sometimes evident between the cortex and medulla and

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sometimes extend into the medulla. Cortical ischæmia was found in some animals and, where not present, the kidneys appeared to be anæmic.

It is a noticeable feature that the red marrow of the long bones was totally destroyed, whereas that of the sternum, ribs and vertebræ appeared to be normal. This occurred in both the treated and untreated cattle.

Apart from evidence of tissue degeneration, various reactive processes have been noted. Splenomegaly has already been mentioned. The general hyperplasia of the hæmolymph tissues is most striking. These glands were found, unconnected with any organ, beneath the skin in various sites. Other glands were found attached to lymphatic glands, kidneys, liver and adrenal. In one case, they were even found embedded in the precrural lymphatic gland and in another (not mentioned above) in the cortex of the adrenal gland. Occasionally, they were found in the region of the alimentary tract, but most commonly along the thoracic portion of the trachea, where they often formed grape-like clusters.

Lesions of the lymphatic system were also constant. Glands throughout the body were hyper-trophied and œdematous and showed a tendency to fibrosis. Sometimes, there were hæmorrhages of the medulla. The trabeculæ of the lungs were generally distended, indicating a varicosity of the lymphatic vessels and lympho-stasis.

The untreated animals gave evidence of a more acute cardiac involvement as shown by sub-epicardial and sometimes sub-endocardial hæmorrhages. The syndrome in them appears to have been similar but more acute in type. Thus the tendency to hæmorrhage, especially in the renal medulla, was intensified. The liver showed congestion, the fore-runner of degenerative processes, but not the degenerative processes themselves. The lymphatic glands were œdematous but not fibrous. The marrow was affected in the long bones, but in one animal only incompletely.

This shows that the type of disease developed in treated animals exposed to constant re-infection sources is a form of modified acute trypanosomiasis. It does not correspond with the chronic post-critical form of the disease as described by Fiennes, Jones and Laws (1946).

Summary

An account is given of the post-mortem findings of 18 cattle which had been exposed to tsetse flies at Kiboko in Kenya. Of these eight had been protected with antrycide, six with dimidium, and four were untreated controls. All the cattle were killed immediately prior to autopsy.

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XUM

THE EFFECT OF DIHYDROTACHYSTEROL ON BOVINE BLOOD CALCIUM, INORGANIC PHOSPHATE AND SUGAR LEVELS

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An investigation has been made to ascertain the effect upon certain bovine blood mineral levels of dihydrotachysterol, with a view to its use in hypocalcæmia associated particularly with parturition.

The drug is a stable, oil-soluble fraction obtained from irradiated ergosterol and has been applied in human medicine to acute, chronic and latent forms of post-operative tetany, in dermatological problems associated with hypoparathyroidism and in Vitamin D deficiency and in other forms of impaired calcium metabolism. (Albright and Reifenstein, 1948; Cedar, 1947; Goldberg and Dexter, 1951).

The pharmacological action of dihydrotachysterol resembles that of parathyriod extract without the disadvantage of tolerance production; the effects are manifested more slowly and sustained for a far longer period (Albright and Reifenstein, 1948). The drug is supplied in oily solution for oral administration, and intramuscular injection of the preparation causes little or no reaction.

Technique of Chemical Analysis

Calcium estimations were made by the method of Kramer and Tisdall as described by Harrison (1949). The phosphorus estimations were made by the method of Fiske and Subbarow as described by Parker (1948), and sugar estimations were made by the Hagedorn and Jensen method (Harrison, 1949) using Somogyi's modified protein precipitate.

The results of three cases are given to illustrate the actions of the drug on blood mineral levels after intramuscular injection.

(1) *Subject:* Six-year-old Ayrshire Cow in lean condition, non-pregnant but lactating (suckling calves); the genital tract was in di-œstral phase. The food, for some weeks beforehand consisted of medium-quality meadow hay with no concentrate supplement.

Five c.c. of "A.T.-10" (Bayer), equivalent to 6.25 mg. of crystalline dihydrotachysterol were injected intramuscularly behind the right shoulder and blood samples were taken immediately before the injection and once daily afterwards.

The animal consumed about twice her usual intake of water during the first twenty-four hour period. A distinct increase in speed of reaction to external stimuli was also observed but subsequently she reverted to her original state and showed no other deviations from normal.

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Analysis of Blood Samples

	Calcium.	Magnesium.	Inorg.P.	Sugar
Before injection ...	13.7	2.4	2.6	27
At 24 hours ...	14.3	2.5	2.4	35
At 48 „ ...	15.2	2.3	2.4	37
At 72 „ ...	14.8	2.6	1.8	46
At 96 „ ...	14.4	2.3	1.25	75

Calcium and magnesium represent mg. per cent serum.
Inorg.P. and sugar represent mg. per cent whole blood.

(2) *Subject:* Seven-year-old Guernsey Cow approaching parturition. Food consisted of medium-quality meadow hay, supplemented by a small daily ration of crushed oats and dairy nuts. Five c.c. of "A.T.-10" (Bayer) were injected and blood samples were taken immediately before injection and for fifteen days afterwards.

At the beginning of these observations on the February 4, 1952, the degree of udder development, relaxation of pelvic ligaments, vulva, vagina and cervix suggested that the cow might calve within 36 hours. All the signs of approaching parturition appeared to regress on February 7, but returned on the evening of February 9 and a live heifer calf was born between 2 a.m. and 6 a.m. on February 10. The cow cleansed quickly and completely, and by 12 noon, marked involution of the uterus had taken place. Lactation proceeded normally and milk secretion reached a prolific level on the fourth day after parturition.

Analysis of Blood Samples

Date and Time of Sampling	Calcium.	Mag.	Inorg.P.	Sugar
4.2.52 11 a.m. (Before injection)	10.6	1.9	5.2	69
4.2.52 5 p.m.	10.8	2.0	4.5	113
5.2.52 11 a.m.	11.1	2.1	4.7	118
6.2.52 11 a.m.	11.8	1.7	4.5	137
7.2.52 11 a.m.	11.3	1.7	4.4	72
8.2.52 11 a.m.	10.8	1.7	3.6	97
9.2.52 11 a.m.	10.3	1.8	3.9	130
	Cow calved			
10.2.52 10 a.m.	10.1	2.1	1.4	154
11.2.52 11 a.m.	10.2	3.0	4.4	97
11.2.52 12 noon	10.4	2.0	4.4	74
12.2.52 11 a.m.	10.5	2.1	4.4	60
13.2.52 11 a.m.	10.6	2.0	4.2	90
14.2.52 11 a.m.	10.7	3.5	4.4	90
16.2.52 10 a.m.	10.7	3.2	3.9	109

Calcium and magnesium represent mg. per cent serum.
Inorg.P. and sugar represent mg. per cent whole blood.

It is interesting to compare these figures with those obtained from the same cow during parturition two years previously; these were as follows:—

				Ca.	Mag.	Inorg.P.
48	hours	before	calving	10.6	2.1	4.6
24	,,	,,	,,	9.8	2.2	4.1
8	,,	after	,,	7.8	3.0	3.8
20	,,	,,	,,	9.2	3.3	3.6
44	,,	,,	,,	9.6	3.0	3.9

Calcium and magnesium represent mg per cent serum
Inorg.P. represent mg. per cent whole blood.

Sugar estimations were not made and no clinical manifestations of hypocalcæmia were seen. While this last set of figures does not provide any strict experimental control it indicates that the cow was of the type which was likely to show hypocalcæmia at parturition.

(3) In the third case herewith reported, a second intramuscular injection of 5 c.c. of "A.T.-10" (Bayer) was given after 24 hours.

Subject: Four-year-old Jersey Cow, neither pregnant nor lactating. Food consisted of medium-quality meadow hay alone.

An increased thirst similar to that described in the first case was noted in this Jersey cow and it persisted approximately 36 hours after the initial injection. Blood samples were taken daily for five days.

Analysis of Blood Samples

Date and Time of Sampling		Calcium.	Inorg.P.	Sugar
13.8.52	10 a.m.	9.8	2.9	43
(Immediately before injection)				
14.8.52	10 a.m.	10.7	0.9	48
(Second injection given)				
15.8.52	10 a.m.	11.2	—*	21
16.8.52	10 a.m.	11.5	0.1	32
17.8.52	10 a.m.	11.6	1.08	41
18.8.52	10 a.m.	11.4	5.0	37

Calcium represents mg. per cent serum.
Inorg.P. and sugar represent mg. per cent whole blood.

*The phosphorus level of the sample taken on 15.8.52 was too low for an accurate estimation.

(4) *Subject:* The effects of oral administration of the drug was studied in an Ayrshire Cow 6½ years old which had calved three weeks previously; it was suckling its calf and giving a further two gallons of milk daily. Food consisted of hay, supplemented by about 8 lb. of crushed oats and dairy nuts daily. Ten c.c. of "A.T.-10" (Bayer) were mixed with 4 oz. of arachis oil and given as a drench. Blood samples were taken immediately before administration and daily for the following six days. During this period none of the clinical abnormalities recorded in the first case, were seen.

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Analysis of Blood Samples

		Calcium.	Inorg.P.	Sugar
Before administration	...	11.4	1.6	35
At 24 hours	...	11.6	1.8	39
„ 48 „	...	11.9	0.8	43
„ 96 „	...	12.6	0.6	48
„ 120 „	...	13.9	1.2	39
„ 144 „	...	14.2	0.9	42
„ 168 „	...	14.0	2.0	55

Calcium represents mg. per cent serum.
Inorg.P. and sugar represent mg. per cent whole blood.

Discussion

The administration of dihydrotachysterol by intramuscular injection or by the mouth produced in the four cases described, consistent rises in the blood calcium levels and these were maintained over an average period of four days. There was a slower response after oral administration and the effects were maintained for a longer period. It is worthy of note that the very high initial level of calcium in the first case, did not prevent an increase in response to the drug.

In the cases studied, the blood phosphate levels showed initial depression although in cases 3 and 4 levels rose eventually to points higher than the initial figures. This might have been recorded in case 1 had samples been taken over a longer period and in case 2 parturition intervened. This initial depression is not emphasised by previous workers particularly in the human field where a direct rise in blood phosphates following "A.T.-10" administration is the accepted view. If, however, a temporary fall does occur in cattle, "A.T.-10" therapy may well be contra-indicated in patients where hypophosphatæmia and not hypocalcæmia is the chief cause of recumbency, unless phosphates are administered concurrently.

An interesting feature is the general increase in blood sugar levels, a fact which might prove of value to the cow in combating degrees of ketosis associated with normal pregnancy and parturition.

The sugar level rose to an exceptionally high figure in case 2. Samples were taken without excitement or undue restraint of the patient, but it is possible that the handling of the animal during the period of approaching parturition, was responsible for an exaggerated effect. The responses before, during, and after parturition were studied and the calcium levels remained consistently high. The blood sugar doubled in 48 hours after which all mineral levels began to fall. This may have been associated with the regression of the signs of approaching parturition and emphasises the fact that the drug may be of greater value when administered at parturition and during the immediate post-parturition period. It is also felt that repeated injections may produce unduly marked initial depression of blood phosphorus levels.

The marked response after oral administration is offset by the slower

manifestation of changes in the blood mineral levels, but the value of this method of therapy should always be considered.

In cases 1 and 2, magnesium estimations are included but these did not show any significant response to the administration of the drug.

Conclusion

The constant elevation of blood calcium levels after the administration of dihydrotachysterol suggests that this drug has a therapeutic indication in potential cases of hypocalcæmia as a means of retarding the development of the condition and in preventing relapses after initial treatment. Further work is necessary to establish the action of the drug upon the blood phosphate level particularly with regard to any detrimental effect in cases complicated by hypophosphatæmia.

Summary

The effect upon blood mineral levels of the injection and oral administration of dihydrotachysterol has been studied in four cows.

The blood calcium was raised and maintained at a higher level and the phosphate level was initially depressed in each cow. Sugar levels increased.

Oral administration produced a slower but more sustained response than that obtained by intramuscular injection.

It is suggested that the drug may be of value in retarding the development of symptomatic hypocalcæmia and in preventing the relapse of cases treated by ordinary methods.

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THE CONFORMATION OF THE SKULL OF THE DOG AND ITS RELATION TO SEX

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Introduction

The skulls of 70 cross-bred, adult dogs, prepared without injury, were examined. They were equally divided, i.e., male and female.

Material and Method

The skulls of 70 cross-bred, adults dogs, prepared without their injury, were examined. They were equally divided, i.e., male and female.

For the sake of uniformity, the comparison was made between normal skulls of the dolichocephalic type which predominates in Egypt. The cephalic

index of this type is about 50 (Sisson and Grossman, 1948). All the dogs were of approximately equal height.

Statistical analysis of the numerical results, by the method of analysis of variance (Snedecor, 1946) was used to test for significance of the differences found between the two sexes.

Result and Discussion

The Average and Standard Deviation of the Length, Breadth and Cephalic Index of the Skull in Both Sexes

	Male			Female		
	No. of Cases	Average	Deviation Standard	No. of Cases	Average	Standard Deviation
Length of Skull	35	20.05 cm.	±1.48	35	17.63 cm.	±1.42
Breadth of Skull	35	10.06 cm.	±0.712	35	8.84 cm.	±0.716
Cephalic Index	35	50.19	—	35	50.12	—

From this table it is evident that:—

(*a*) The difference in the average cephalic index between male and female skulls is insignificant. This indicates that both groups belong to the dolichocephalic type and enhances the value of other points of comparison.

(*b*) There are differences in the average length and breadth of the skull between the two sexes which were found to be highly significant after statistical analysis. These indicate that the skull in the male is bigger than in the female. However, this cannot be used as a certain means of differentiation between the sexes. Biological variations of size often occur, which do not warrant a final decision between both sexes on the basis of the size of the skull only.

Careful examination of the other parts of the skull revealed the following interesting variations:—

The parietal, interparietal and frontal crests were more defined and prominent in the male than in the female skulls.

The external occipital protruberance was better developed and more convex in the male than in the female.

The frontal bones in the male were dished centrally and flat or slightly convex in the female.

The outline of the foramen magnum was almost circular in the male and somewhat compressed dorso-ventrally in the female.

The mandibles and the maxillæ of males are bigger than those of females.

Although the above are the salient characteristic features of the skull in both sexes, it has been found that the criterion of sexual differentiation of the skull depended mainly on the obvious prominence of the parietal crest and the dished appearance of the frontal bones.

Summary

Part	Male Skull	Female Skull
1. Parietal, interparietal and frontal crests	Prominent	Not prominent
2. Frontal bones	Dished centrally	Flat or slightly convex
3. External occipital protruberance	Well developed and convex	Ill-defined
4. Foramen magnum	Almost circular	Depressed dorsoventrally
5. Mandible and maxillæ	Big	Small

Acknowledgment

I wish to acknowledge my indebtedness to Prof. Mohamed Emara, Faculty of Medicine, Cairo, for his guidance throughout this study.

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THE INCIDENCE OF *CANDIDA ALBICANS* IN THE CROPS OF FOWLS

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Candida albicans infection of the crops of turkey poults has been known in this country for some years but the first recorded outbreak was that observed by Buxton, Darcel, Gordon and Horton-Smith (1949). Losses in fowls, as distinct from turkeys, were reported by Wilson (1949). In 1950 Blaxland and Fincham published their observations on five outbreaks in turkey poults, together with the results of the routine examination of the crops of 55 turkeys and 63 fowls for *C. albicans*. Further work on similar examinations was published in 1952 (Blaxland 1952) but isolation of *C. albicans* was only attempted from those crops showing macroscopic lesions.

The following work was undertaken to discover the incidence of this yeast in the crops of fowls which died from causes other than *C. albicans* infection, and to see whether its incidence could be associated with age, the type of husbandry, or management. The examination extended over a period of twelve months (October 1, 1950 to September 30, 1951) and was conducted on carcases of all fowls dying during that time on 33 farms in Mid-Wales. The number of carcases examined was fairly uniformly distributed over the counties of

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Brecon, Cardigan, Montgomery and Radnor and the methods of poultry husbandry and feeding on these farms were well known to the author.

Technique

The crop was opened, the contents emptied and discarded and the wall gently washed by a stream of sterile distilled water or saline. The epithelial surface was examined for lesions. With a platinum loop several random scrapings of the epithelium were made, including lesions if present, and the material was sown on Sabouraud's maltose agar.

The plates were incubated for 48 hours at 37° C. and, if no growth occurred, for a further five days at 22° C. Films of any yeast-like colonies were examined by staining with ten per cent Nigrosin. Yeast colonies were then submitted to Dr. Ainsworth of the University College of the South-West, Exeter, or to Mr. Blaxland of the Veterinary Laboratory (Ministry of Agriculture), Weybridge, for further identification.

Results

A total of 378 fowl carcases and crops were examined from 33 non-accredited farms, on a few of which backyard type of management was practised; 69 were birds under 2 months old, 69 were 2-6 months of age, and 240 were over 6 months (Table I). The percentage of crops from which *C. albicans* was isolated in these three groups was 1.4 per cent, 16 per cent and 28.7 per cent respectively.

TABLE I

Relation between the isolation of *C. albicans* and age of birds.

	Total	under 2 months	2-6 months	over 6 months
No. birds examined	378	69	69	240
No. birds from which *C. albicans* isolated	81 (21.4%)	1 (1.4%)	11 (16%)	69 (28.7%)

This shows some correlation between the incidence of the yeast and increasing age in the birds. The incidence of *C. albicans* was fairly evenly distributed over the four counties of the investigation. During the period of the investigation, no outbreak of moniliasis occurred and in none of the birds examined could death be attributed to *C. albicans* infection.

In only 13 of the 378 carcases examined were macroscopic crop-lesions found; eleven were in birds over six months and two in birds two to six months old. The lesions were in the form of surface erosions, with or without epithelial thickening. *C. albicans* was isolated from all crops showing lesions.

The association of *C. albicans* with type of management was investigated only for birds over two months of age (Table II). Within the first two months of life various types of management from intensive to free range were practised, often on the same flock of chicks and, in any case, *C. albicans* was isolated from only one crop in this group.

TABLE II

Relation between the isolation of *C. albicans* and type of management.

Type of Management	No. of farms	Total No. birds examined	No. crops from which *C. albicans* isolated
Intensive: Deep litter, battery, strawyard	8	36	14 (38%).
Semi-intensive: Including backyard management	10	72	17 (23.5%)
Folds	3	37	10 (27.3%)
Free Range	14	164	39 (23.7%)

For the purpose of this survey it was convenient to divide the types of management into four groups:—

Intensive, including deep litter, battery and strawyard;
Semi-intensive, including backyard management;
Folds; and
Free Range.

There appeared to be a greater incidence of *C. albicans* under the intensive systems of management (38 per cent) as compared with the other systems which ranged from 23.5 per cent to 27.3.

One of the flocks in deep litter showed evidence of overcrowding and the proportion of fæces to litter was high, but in spite of this *C. albicans* was not isolated from the crops of four adult birds from this source.

Under the fold system, the folds were usually moved every other day or at least twice per week. The semi-intensive and free range houses were generally fairly clean, although cleaning varied from weekly to three-weekly periods, even on the same farm.

There appeared to be no association between the occurrence of this yeast in poultry crops and the time of the year.

Feeding on all premises included proprietary food, with or without grain, scraps, etc., and as it was so variable it was not possible to relate the type of feeding to the incidence of *C. albicans*.

Discussion

The mode of examination was not exhaustive for the presence of *C. albicans* on the lining of the crop. It is probable that more infection was missed in older birds than in chicks because proportionally more of the crop wall would be scraped from the latter birds. It may well be, therefore, that the incidence of *C. albicans* in all age groups, especially in older birds, is even higher than the results suggest. The higher incidence with age may be associated with the greater opportunity for the older bird to pick up *C. albicans*.

Blaxland and Fincham (1950) examined 63 fowl carcases and found crop lesions in 35 (55 per cent) and isolated *C. albicans* from nine only (14 per cent). In contrast, in our own investigation, macroscopic crop lesions were found in only 13 of 378 birds (3.4 per cent), although *C. albicans* was isolated from 81 (21 per cent) including the 13 with lesions. It is interesting to note that Bullis wrote in Biester and Schwarte (1952) (p. 446): "Because of the possibility of

cultivation of *C. albicans* from apparently normal tissues, an original heavy growth is considered essential for diagnosis."

Summary

Candida albicans was isolated from the crops of 81 of 378 fowls dying from a variety of causes; crop lesions were found in only 13 of these. In no case was *C. albicans* thought to be the cause of death.

The incidence of *C. albicans* was slightly greater in birds on intensive systems of management and there was a markedly higher incidence in older birds.

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REVIEW

CALL THE VET, by Nancy Martin. London: Macmillan & Co., Ltd. Price 6s. 6d. net.

THE central figure of this story is a boy called " Ricky " whose father sends him to spend a holiday on a farm.

His introduction to country life was rather hectic for on his way from the station to the farm he was chased by a bull, an adventure which one would presume would be sufficient to damp ones enthusiasm for country life and suppress any desire to be a veterinary surgeon.

Ricky meets two young friends, Vanda, a redhaired girl who has a way with horses and dogs, and Bill, a veterinary student, the son of the local veterinary surgeon.

He goes " on the rounds " with Bill and his father and the various episodes which he witnesses, and which are described quite well, give the reader a fair idea of the life and work of a country veterinary surgeon.

Such an " apprenticeship " has caused many boys to decide on their future career and Ricky was no exception. This book can be recommended as a suitable Christmas gift.

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